

WHAT IS CLAIMED IS:

1. An FM transmitter, comprising:  
a phase lock loop including a charging pump;  
5 an adder to add up a frequency shift to a signal of  
said phase lock loop, said frequency shift corresponding  
to a transmission signal; and  
a controller to receive a signal regarding start and  
idle of said phase lock loop, and to output a control  
10 signal to control an output of said charging pump.

2. The FM transmitter according to claim 1,  
wherein said FM transmitter further comprises:  
a buffer amplifier to input a signal from said phase  
15 lock loop and to output a signal to an antenna,  
wherein said controller further receives a signal  
regarding start and idle of said buffer amplifier, and  
outputs a control signal to control an output of said  
charging pump to switch status of said phase lock loop  
20 between open and closed.

3. An FM transmitter according to claim 1,  
wherein said phase lock loop further includes a phase  
comparator, a loop filter, a voltage controlled  
25 oscillator, and a counter,  
wherein said FM transmitter further comprises to  
output a signal to an antenna, and  
wherein said FM transmitter further comprises a  
controller to receive a start/idle signal of said phase

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lock loop, as well as a start/idle signal of said buffer amplifier and to output a control signal to hold an output of said charging pump in a high resistance state.

- 5           4. The FM transmitter according to claim 3,  
          wherein said controller comprises:

          a delay circuit to delay a start/idle signal of said buffer amplifier; and

- a flip-flop circuit to receive an output of said  
10   delay circuit at one input terminal and a start/idle signal of said phase lock loop at the other input terminal, said flip-flop circuit being set by said start/idle signal of said phase lock loop and reset by said output of said delay circuit, and

- 15           wherein said phase lock loop is controlled so as to be held in closed loop control between a start-up timing of said phase lock loop and a timing delayed by a certain time from said start-up of said buffer amplifier and held in open loop control in other periods.

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5. The FM transmitter according to claim 3,

- wherein said controller comprises a preamble detector to detect a preamble signal included in said transmission signal and a flip-flop circuit to be set by said  
25   start/idle signal of said phase lock loop and reset by said output of said preamble detector, and

          wherein said phase lock loop is controlled so as to be held in closed loop control between a start-up timing of said phase lock loop and a transmission timing of said

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preamble signal, and held in open loop control in other periods.

5           6. The FM transmitter according to claim 3,  
          wherein said charging pump is provided with a logical  
circuit to suppress a frequency control signal output from  
said phase comparator according to a control signal output  
from said controller.

10          7. The FM transmitter according to claim 4,  
          wherein said charging pump is provided with a logical  
circuit to suppress a frequency control signal output from  
said phase comparator according to a control signal output  
from said controller.

15           8. The FM transmitter according to claim 5,  
          wherein said charging pump is provided with a logical  
circuit to suppress a frequency control signal output from  
said phase comparator according to a control signal output  
20 from said controller.

          9. The FM transmitter according to claim 3,  
          wherein said charging pump is provided with a switch  
to reset a bias current to zero according to a control  
25 signal output from said controller.

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10. The FM transmitter according to claim 4,  
wherein said charging pump is provided with a switch  
to reset a bias current to zero according to a control  
signal output from said controller.

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11. The FM transmitter according to claim 5,  
wherein said charging pump is provided with a switch  
to reset a bias current to zero according to a control  
signal output from said controller.

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12. The FM transmitter according to claim 3,  
wherein said controller comprises:

an offset detector to detect an offset of the number  
of "H" or "L" generated transmission signals, said offset  
detector detecting whether an absolute integration value  
that denotes said offset of the number of generated "H" or  
"L" transmission signals, obtained by integrating said  
transmission signals, exceeds a predetermined threshold;  
and

a flip-flop circuit to be set by said start/idle  
signal of said phase lock loop and reset by said output of  
said offset detector, and

wherein said phase lock loop is controlled so as to  
be held in closed loop control between a phase lock loop  
start-up timing and a timing of detection of said  
predetermined threshold exceeded by said offset of the  
number of "H" or "L" generated transmission signals by  
said offset detector and to be held in open loop control  
in other periods.

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13. A transmitter to transmit a signal with FM modulation, wherein the transmitter receives a start/idle signal of a phase lock loop circuit and a start/idle signal of a buffer amplifier, and outputs a control signal  
5 to hold an output of a charging pump at a first level of resistance at which a bias current is substantially zero, and

wherein said phase lock loop circuit is moved into open loop control when the output of the charge pump is  
10 held at the first level of resistance.

14. The transmitter for FM transmission according to claim 13,

wherein said signal to be transmitted has a preamble,  
15 and said phase lock loop circuit is controlled for the loop to be closed or opened based on said preamble.

15. The transmitter for FM transmission according to claim 13,

20 wherein said transmitter includes a controller comprising:

a delay circuit to delay a start/idle signal of said buffer amplifier; and

a flip-flop circuit to receive an output of said  
25 delay circuit at one input terminal and a start/idle signal of said phase lock loop at the other input terminal, said flip-flop circuit being set by said start/idle signal of said phase lock loop and reset by said output of said delay circuit, and

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wherein said phase lock loop is controlled so as to be held in closed loop control between a start-up timing of said phase lock loop and a timing delayed by a certain time from said start-up of said buffer amplifier, and held  
5 in open loop control in other periods.

16. The transmitter for FM transmission according to claim 13,

wherein said transmitter includes a controller  
10 comprising a preamble detector to detect a preamble signal included in said transmission signal and a flip-flop circuit to be set by said start/idle signal of said phase lock loop and reset by said output of said preamble detector, and

15 wherein said phase lock loop is controlled so as to be held in closed loop control between a start-up timing of said phase lock loop and a transmission timing of said preamble signal, and held in open loop control in other periods.

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17. An FM transmitter, comprising:

a phase lock loop not including a sample-and-hold circuit; and

an adder to add up a frequency shift to a signal of  
25 said phase lock loop, said frequency shift corresponding to a transmission signal,

wherein said phase lock loop is controlled to switch status of said phase lock loop between open and closed without the use of a sample-and-hold circuit.

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18. The FM transmitter according to claim 17,  
wherein said phase lock loop includes a charging  
pump, and

wherein said FM transmitter includes a controller to  
5 receive a signal regarding start and idle of said phase  
lock loop, and to output a control signal to control an  
output of said charging pump.

19. The FM transmitter according to claim 17,  
10 wherein said FM transmitter includes a buffer  
amplifier to input a signal from said phase lock loop and  
to output a signal to an antenna,

wherein said buffer amplifier is provided to receive  
a signal regarding start and idle of said buffer amplifier  
15 through from another path than the path from said phase  
lock loop.

20. The FM transmitter according to claim 17,  
wherein said phase lock loop includes a charging  
20 pump, and

wherein said FM transmitter further comprises:  
a buffer amplifier to input a signal from said phase  
lock loop and to output a signal to an antenna; and  
a controller to receive a signal regarding start and idle  
25 of said phase lock loop and a signal regarding start and  
idle of said buffer amplifier, and to output a control  
signal to control an output of said charging pump to  
switch status of said phase lock loop between open and  
closed.

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